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THE BOTANICAL GAZETTE

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VOL. XVI. NO. 12.—BOTANICAL GAZETTE.—DEC., 1891.

On the relationships of the Archegoniata.[1]

DOUGLAS HOUGHTON CAMPBELL.

Under the name of Archegoniata are usually included the bryophytes and pteridophytes, but we may also include with them the gymnosperms, as all three groups agree in the presence of an unmistakable archegonium, which while differing in some details has such similarity of structure as to point to an almost certain, although remote, common origin for all three groups.

This homology was first shown by Hofmeister[2] in his remarkable series of investigations upon the higher cryptogams and gymnosperms, and has since been the subject of numerous investigations, so that a great mass of material has accumulated.

Numerous attempts have, of course, been made to trace out the inter-relationships of these groups; but recently a good many new facts have been discovered which may throw a somewhat different light upon these, and it is the intention here to call attention to these, and attempt to point out what their bearing is upon the point in question. In trying to do this, the data assumed are mainly derived from the results of a developmental study of the different forms, coupled with such evidence as the palæontological record has to show. Unfortunately the latter is too fragmentary, as regards the lower forms and the more delicate parts of the higher ones, to be of very much service in the study of these points; still very valuable material has been brought to light, and probably much more will be discovered if a systematic search is made.

It is generally admitted that we are to look for the ancestors of the higher plants among the fresh water green Algæ. On account of the structure of the sexual organs, as well as the occurrence of a sort of protonema, the Characeæ have sometimes been regarded as the nearest approach among existing Algæ to the mosses; but if this is so, the ancestral forms must have been of a much less specialized character than even

[1] Read before Section F, A. A. A. S., Washington Meeting, August, 1891.
[2] The higher Cryptogamia.

the simplest of living forms, and it seems more probable that of living Algæ, the higher Confervaceæ such as *Coleochæte*, come nearer to this hypothetical form.

The first of the groups with which we have to deal, the Bryophyta, or Muscineæ, is readily divisible into two classes, the liverworts (Hepaticæ), and true mosses (Musci). There has been some controversy as to which of these is nearest the primitive stock, and to the higher plants. A comparison of the two groups will show, however, very strong reasons for considering the Hepaticæ as the more primitive group. Although far outnumbered in species by the true mosses, the Hepaticæ show a much greater diversity of form, both of the gametophyte and sporophyte than is the case with the Musci, which form a remarkably close group with relatively insignificant differences (excepting in the case of *Sphagnum*); and the higher ones, with their very peculiar and highly specialized sporogonium, are evidently very remote from any other group of plants. The Hepaticæ, on the other hand, offer a very strong contrast to this. Several divergent stocks are evident, all traceable to a common form and touching in certain respects, Algæ, Musci, and Pteridophyta. The thallus of such simply organized forms as *Anthoceros* or *Pellia*, is but a slight advance on the higher green Algæ, although it must be borne in mind that this simplicity does not extend to the sexual organs and sporophyte. On the other hand, these same forms are connected directly with the Musci through *Sphagnum*, and as the writer has endeavored to show before,[1] to such pteridophytes as *Ophioglossum*.

If we now study a little more closely the relation of the Hepaticæ, *inter se*, we can distinguish three well-marked series of forms diverging from a common stock. Nearly all liverworts pass through a more or less well-marked thallose stage which is persistent in some of the simpler thallose Jungermanniaceæ such as *Aneura* and *Metzgeria*. This is a simple flat often heart-shaped thallus, growing from a single apical cell. It is usually, although not always, traversed by a well-marked mid-rib. The frequent recurrence of this stage in the development of so many forms of Hepaticæ, as well as in the prothallium of the isosporous ferns, is most readily explained by the assumption that this represents the ancestral type from which both groups have sprung. Granting this to

[1] The affinities of the Filicineæ: Bot. Gaz. Jan., 1890.

be the case, the thallose Jungermanniaceæ are to be regarded as the most primitive of living forms, and not the Ricciaceæ, which are usually so considered. It seems more likely that the latter, together with the very closely related Marchantiaceæ, represent a group in which the thallus has become highly differentiated, without a corresponding development of the sporophyte, and which reaches its highest expression in such forms as *Marchantia* and *Asterella*. Of course it is possible to regard the simpler Ricciaceæ as the primitive forms from which the Jungermanniaceæ have sprung; but this would involve a reduction of the thallus in the latter which seems hardly probable, as in some Marchantiaceæ, and probably in the Ricciaceæ also, the young thallus corresponds closely to to that of the simpler Jungermanniaceæ, and the massive thallus of the older plant arises secondarily. The very simple sporogonium of *Riccia*, of course, is an important point in determining its systematic position, and indicates, that if, as here suggested, the Ricciaceæ are derived from forms like the lower Jungermanniaceæ, it must have been at a very early period, before the sporogonium of the latter had reached its present stage of development.

Leitgeb[1] has already called attention to the connection of *Anthoceros* with the Jungermanniaceæ, and the evolution of the foliose forms of the latter group from the thallose forms is easily demonstrated.

We may then pretty safely assume that the primitive liverworts were thallose forms not unlike such existing forms as *Metzgeria*, or the prothallium of an *Osmunda*, and that from these, three stocks diverged, the Ricciaceæ (including Marchantiaceæ), the Anthoceroteæ, and the foliose Jungermanniaceæ. The first and third of these groups forming the great bulk of the living forms are to be regarded as specialized branches that end blindly; the second, however, is especially important from a morphological standpoint, as it probably represents to a considerable degree, the ancestral form from which both the true mosses and the Pteridophytes have sprung.

The Anthoceroteæ[2] differ remarkably from the other liverworts, especially in the development of the highly specialized sporogonium. This finds its nearest homologue, not among the Hepaticæ, but in the lowest order of the true mosses, viz.:

[1] Untersuchungen über die Lebermoose, Vol. V, pp. 8-9.
[2] Leitgeb, l. c.

the Sphagnaceæ. The close similarity in the development of the sporogonium in these two groups, can only be explained on the assumption of a common origin, and this is strengthened by the fact that the protonema of *Sphagnum* is a large, flat thallus instead of the filamentous form common to most mosses. In short, *Sphagnum* forms a link between *Anthoceros* and the true mosses.

This is true of the protonema, as well as the sporogonium, for while the younger protonema is at first a simple flat thallus, later there may grow out from its margin filaments which have all the characters of the ordinary protonemal branches of the higher mosses, including their peculiar oblique septa. These filamentous branches, as well as the leafy stem, are secondary, and it is difficult to see how we can assume that the former represents the primitive condition, as Goebel[1] and Bower[2] assert. It seems much more in accordance with the facts to believe that the flat thallus represents the primitive form of all, and that in the mosses, as the leafy branches bearing the sexual organs became more and more prominent, the large prothallium-like protonema gradually became lost, being replaced by the secondary filamentous form found in most mosses.

The foregoing attempt to point out the connection of the different groups of the bryophytes may be illustrated by the diagram on the opposite page.

The probable connection of the Anthoceroteæ with the Filicineæ has been noted by several investigators,[3] but the assumption has been usually made that the relationship must be sought with the Leptosporangiatæ, as these have been regarded as the lowest of the forms. Of the leptosporangiates the Hymenophyllaceæ have usually been regarded as the most primitive, this opinion being based mainly upon the delicate character of the sporophyte. The most recent investigations, however, do not bear this out, and the attempt of Prantl[4] to homologize the sporogonium of *Anthoceros* with the sporophyte of *Hymenophyllum* involves such an amount of pure speculation and so little real morphological correspondence as to be very far from convincing.

[1] Morphologische u. biologische Studien: Ann. du Jardin botanique de Buitenzorg, Vol. VII, p. 115.

[2] Annals of Botany, Vol. III, No. 11, p. 372.

[3] Leitgeb, l. c., Vol. VI, p. 60. — Prantl, Hymenophyllaceæ, p. 62.

[4] L. c., p. 62.

From a very careful study of the question, the writer[1] was led to a very different view as to the relative position of the different groups of the Filicineæ, and gave what seemed to him strong evidence in favor of considering the eusporangi-

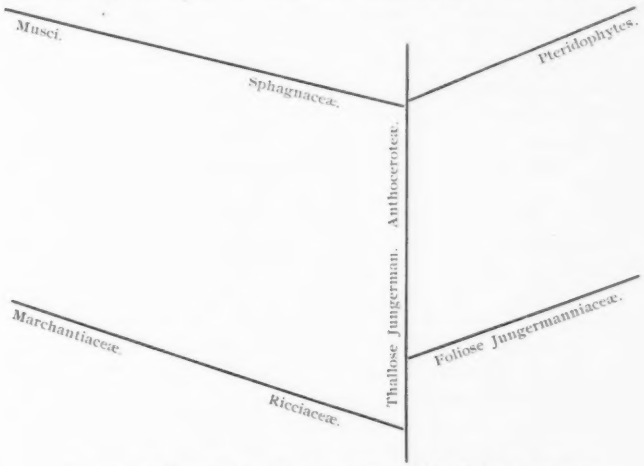

DIAGRAM 1, illustrating the inter-relationships of the bryophytes.

ate forms, which hitherto were regarded as the highest of the ferns, as the primitive forms from which the Leptosporangiatæ have been derived. Ophioglossum was considered to be the nearest of the existing forms to this ancestral form, so far as can be judged from a study of the structure of the sporophyte.

Of the three classes of the pteridophytes, the ferns form a very large majority and constitute the prevailing type of the existing forms. If we compare the number of species in the three classes, we shall find that the Filicineæ comprise at least 90 per cent. of living forms, and that of the 3000 or more species of ferns an overwhelming majority belong to one family—the Polypodiaceæ. This fact, in connection with the highly differentiated sporangium, and other structural peculiarities, led me to express the opinion that the Leptosporangiatæ (of which the Polypodiaceæ are the type), instead of representing the primitive group of ferns, were in fact a com-

[1] Affinities of the Filicineæ, p. 3.

paratively modern, specialized group, comparable to the leafy liverworts or the true mosses. There is no geological evidence to show that the true leptosporangiate ferns were ever much more numerous or better developed than at the present time. On the other hand, the geological record, as well as embryological study, so far as the latter has been applied to them, points to the primitive nature of the Eusporangiatæ.

The most recent and careful study of the carboniferous and pre-carboniferous ferns, show that their affinities were not with the Leptosporangiatæ, but with the Eusporangiatæ, especially the Marattiaceæ. Forms probably referable to the Ophioglosseæ, and probably also to the Osmundaceæ,[1] have also been found, but no unmistakable leptosporangiate remains are known until the early Mesozoic formations, from which time they increase rapidly in number and variety. Solms-Laubach[2] justly remarks that if such forms did exist in the earlier formations, it is exceedingly strange that, among the innumerable perfectly preserved leaves, a structure so durable as the annulus of the sporangium should have failed to be preserved in a recognizable condition.

The ontogeny of the Eusporangiates, so far as known, harmonizes with the geological evidence. The prothallium is more massive, and longer-lived than in the leptosporangiates, in this respect approaching the liverworts, and the sexual organs show points of primitive structure. Unfortunately the embryogeny is scarcely at all known in any of the homosporous forms, which are presumably the most primitive and approach most nearly the ancestral type.

From a series of investigations recently completed by the writer, it appears that the Osmundaceæ are about midway between the true Eusporangiatæ and the Leptosporangiatæ, both in regard to the prothallium and the embryo. The intermediate character of the tissues of the sporophyte has already been repeatedly called attention to by various writers. The prothallium resembles to a remarkable degree that of certain liverworts, notably *Dendroceros*, and the sexual organs approach in certain respects the Marattiaceæ, but also recall *Equisetum* and even certain bryophytes. The embryo is noticeable on account of the large size of the foot and its long depend-

[1] Solms-Laubach: Palæophytologie, p. 156.
[2] Bower: Annals of Botany, May, 1891.
[3] L. c., p. 156.

ence upon the prothallium, as well as the great development of the calyptra, all of which are evidences of the primitive character of the group, and in all of which, so far as known, it approaches the Eusporangiatæ. An interesting point noted was the fact that the primary root grows from a single tetrahedral apical cell, as in all of the Filicineæ except the Marattiaceæ and *Isoetes*, while the later roots, at least of the two species studied, *O. Claytoniana* and *O. cinnamomea*, possess a four-sided pyramidal apical cell. This seems to indicate that the former is the primitive form which has been retained in all except the Marattiaceæ and the probably allied *Isoetes*. Whether this state of things obtains in the embryo of the former of these is not known, but it is not impossible; in the latter a trace of this is sometimes seen in the very earliest stages of the embryo, but is lost before the root is fully grown.[1]

In the course of these investigations points of resemblance, both in the prothallium and sexual organs were noted, that recalled the corresponding points in *Equisetum*. So numerous were these, that it led to a belief of a nearer relationship between the Equisetineæ and Filicineæ than is usually maintained, and to warrant the possible union of the two classes into a group opposed to the Lycopodineæ. Van Tieghem[2] has called attention to correspondences in the sporophytes of *Equisetum* and *Ophioglossum* which confirm this view. It is even possible that this might be carried so far as to assume a common origin for these two classes, distinct from that of the Lycopodineæ which in some respects recall rather the true mosses than the liverworts. One great difficulty in dealing with the Lycopodineæ, and especially the Equisetineæ, is that they are degenerate forms which have lingered after their larger and better organized kindred have disappeared, and it is difficult to judge which are primitive and which secondary characters. Certain it is, that the investigated species of *Lycopodium*[3] differ more from *Equisetum*, than does the latter from the homosporous Filicineæ. Still we are not yet in a position to speak positively on this point.

Of the true leptosporangiate ferns, the reasons already given

[1] Campbell: Annals of Botany, Vol. V, No. 19, p. 243.
[2] Unfortunately the paper was not accessible.
[3] Treub: Études sur les Lycopodiacées, Ann. du Jardin botanique de Buitenzorg. Vols. 4, 5, 7.

seem to warrant the assumption that in the Polypodiaceæ we have to do with a group of comparatively modern forms that have arisen from the more ancient Eusporangiatæ through the Osmundaceæ, Gleicheniaceæ and Cyatheaceæ, which families constitute a quite natural series. The two families, Hymenophyllaceæ and Schizæaceæ, while evidently connected with the lower members of this series, seem to form two offshoots from the main line of ascent, and the former is probably a degenerate group whose peculiarities are largely due to the effects of environment. The affinities of the Hymenophyllaceæ seem to be with the Gleicheniaceæ and Osmundaceæ. The form of the sporangium and spores, as well as the prothallium and sexual organs, is of the type found in these groups. The branching filamentous prothallium, upon the importance of which too much stress has been laid, is by no means rare in *Osmunda Claytoniana* under certain circumstances, and the form of the sexual organs is very similar.

As to the sporophyte, the Ophioglosseæ form a natural series with *Ophioglossum* at the bottom, and such species of *Botrychium* as *B. Virginianum* at the top, the latter connecting the group with the Osmundaceæ.

The Marattiaceæ, as might be expected of such ancient forms, show affinities with both the Osmundaceæ and Ophioglosseæ, and may perhaps be regarded as a branch of the original stock that, beginning very far down, reached its maximum development in the Carboniferous era, and then declined. Whether, as suggested by Bower,[1] the spermaphytes have arisen from the same stock, must at present remain conjectural.

The forms hitherto discussed are the so-called isosporous forms. Among the existing pteridophytes, however, are four very distinct groups in which spores of two kinds are found, viz.: Selaginelleæ, Isoeteæ, Marsiliaceæ, and Salviniaceæ. The first of these is evidently enough related to *Lycopodium*, and the third to the Polypodiaceæ; but the affinities of the others are not so clear. The Salviniaceæ, while clearly enough belonging to the Leptosporangiatæ, and related to the lower members of the series, still are so peculiar that it is not easy to decide where they should be placed. Prantl[2] suggests the Hymenophyllaceæ as their nearest allies, and prob-

[1] Annals of Botany, Vol. III, p. 387.
[2] The Schizæaceæ, p. 153.

ably either these or the Schizæaceæ are to be so considered. *Isoetes* is even more difficult to place. It is unquestionably the nearest among living pteridophytes to the spermaphytes, but with what group of homosporous ferns it is most nearly related, is hard to say; for while showing evident relationship to several forms, they are in widely separated groups. On the whole, the evidence is in favor of regarding it as nearest the Marattiaceæ; but this is liable to be changed when the embryogeny of the latter is known, and the life history of the Ophioglosseæ. (See diagram 2.)

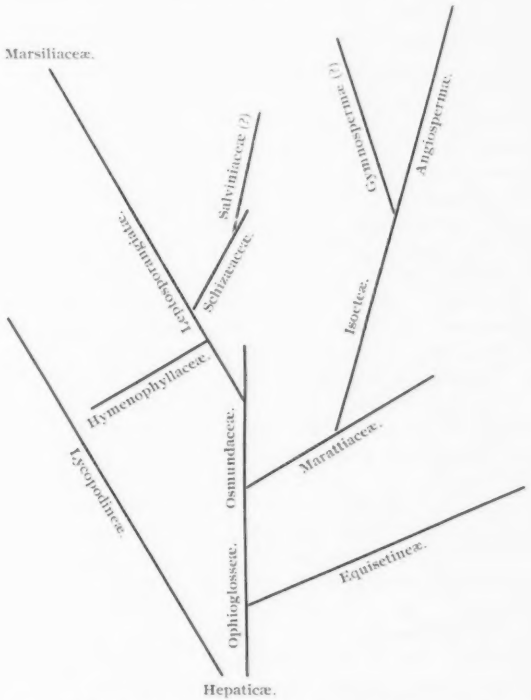

DIAGRAM 2, illustrating the ontogeny of the vascular cryptogams and spermaphytes.

The tendency toward the separation of the sexual organs, occasionally found in nearly all forms examined, occurs regu-

larly in *Equisetum* and many Polypodiaceæ. This tendency has been attended by a greater and greater reduction of the prothallium, which finally, in such forms as *Isoetes*, has lost all power of independent existence, and serves simply to nourish the sporophyte until it can live alone. In these two, the sex of the prothallium is already indicated by the two sorts of spores. This carried a step further resulted in the macrospore being retained permanently within the sporangium which did not separate from the sporophyte until the prothallium was developed.

At first, as is still the case in *Ginkgo*[1] and some cycads, fertilization was not effected until after the sporangium (seed) became detached; but in the higher forms, fertilization and the formation of the embryo were completed before the seed ripened, as is seen in the Abietineæ, for example.

Inasmuch as heterospory was developed independently in several widely separated groups, the question naturally arises whether the formation of seeds may not also have taken place in more than one line, and that all of the spermaphytes have not necessarily arisen from the same stock.

The great gap between gymnosperms and angiosperms it is at present impossible to bridge over, and the possibility of a separate origin of the latter directly from some group of pteridophytes is by no means improbable. The writer's recent investigations upon the embryo of *Isoetes*[2] have shown that it much more nearly resembles that of a typical monocotyledon than it does the gymnosperms, and as the prothallium is hardly more differentiated than in the latter, it is about as easy to imagine the monocotyledons to be derived directly from forms like *Isoetes* as from the gymnosperms.

As might be expected, there is much difference of opinion concerning the inter-relationships of the spermaphytes. The view ordinarily accepted is that of Strasburger,[3] who derived the gymnosperms from forms intermediate between ferns and lycopods, but having their nearest affinity among living forms with *Selaginella*. This common stock then divided into two branches, cycads and conifers, and from the latter through the Gnetaceæ, were derived the dicotyledons, from which as a degenerate group the monocotyledons have descended.

[1] Goebel: Outlines, p. 338.
[2] The life history of Isoetes echinospora, Ann. of Bot. Vol. V. No. 19.
[3] Coniferen und Guetaceen, p. 258.

Kny[1] claims a distinct origin for the two divisions of the angiosperms. He says, "The two principal divisions of the angiosperms, dicotyledons and monocotyledons, represent two great independent lines of development, whose origin reaches at least as far back as the vascular cryptogams, if not lower." He is inclined with Strasburger to connect conifers and dicotyledons with the Lycopodineæ, and would derive the monocotyledons directly from the ferns.

Prantl's[2] views are much the same as Kny's, except that possibly a part of the dicotyledons have a common origin with the monocotyledons.

From the evidence at present available, both of embryology and palæontology, the assumption of a separate origin for the two groups of the angiosperms is certainly unwarrantable. In all forms yet investigated, the uniformity in the essential structure of the flowers, and especially the development of the embryo-sac, points unmistakably to a common origin. It may be that further investigations upon the lower members of both groups may modify this view, but that such extraordinary correspondence as exists in the formation of the embryo-sac, the structure of the egg apparatus, the fusion of the endosperm nuclei, etc., could have arisen independently in the two groups is inconceivable.

On the other hand, the evidence for a direct connection of gymnosperms and angiosperms, is not entirely convincing, and the possibility of a separate origin for these two groups is by no means unlikely—nay, seems quite probable.

Whether the origin of the angiosperms is to be looked for directly from the Filicineæ, through such forms as *Isoetes*, or from forms higher up like the cycads, can only be satisfactorily answered after many forms have been thoroughly studied. As yet our knowledge of the embryology of the cycads and the simplest angiosperms is too incomplete to make an answer to this question more than a mere conjecture.

Palo Alto, California.

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[1] Entwickelung der Parkeriaceen, p. 61.
[2] Hymenophyllaceæ, p. 68.

A new herbarium pest.

C. V. RILEY.

In the year 1890 a number of small Geometrid larvæ, recalling somewhat in appearance those of the genus Aplodes, were found by the botanists of the Department of Agriculture infesting certain dried plants in the Department herbarium, and especially those which had been received from Mexico and Lower California, from Dr. Edward Palmer. Dr. J. N. Rose first observed it in January, 1890, on plants from La Paz, but it was still more abundant in a collection from the State of Colonna, Mexico, made in the beginning of the present year. Being referred to me for identification, I became much interested in the matter, as it was the first case that had come under my notice of a Geometrid larva feeding upon dried plants. The matter acquired additional interest also because the species was evidently new and there was danger of its being spread through distribution into other parts of the world. I therefore took steps to watch the course of the insect and rear it to the imago state. This was done some time ago and I have had drawings of the different stages finished for some time, and call attention to the matter now because the trouble has grown in the Department herbarium and it is of sufficient importance to put on record. The first moth emerged October 22d, 1890, and others were subsequently reared from material received from time to time from the Department herbarium. While the larva was first discovered, as stated, on Mexican plants, it has not confined its work to such plants, but has spread to others and is by far the most destructive herbarium pest which the botanists in charge have to deal with. Plants of the genus Coulterella, for example, which were sent by Dr. Rose to Dr. C. Hoffman in Berlin, have been so injured that but one perfect flower remained; yet, according to the observations of Mr. L. H. Dewey, in overhauling the herbarium, the insect's work is still mostly confined to southwestern plants; after these from Mexico, chiefly those from California. In some cases eastern plants have not been attacked, even when associated with western, but in one case at least, viz.: Rhus toxicodendron, eastern plants have been extensively infected.

The larvæ feed on the flowers and also to some extent on the leaves. More rarely they feed on the hard fruits and seeds. The following list, kindly prepared by Mr. Dewey,

of the plants upon which the larvæ had been found prior to its work on Rhus toxicodendron will be of interest in this connection.

Species.	*Order.*	*Locality.*
Ptelea aptera	Rutaceæ	S. California.
Ceanothus sorediatus	Rhamnaceæ	S. California.
Dalea Seemanii	Leguminosæ	S. California.
Lupinus coccineus	Leguminosæ	Arizona.
Purshia tridentata	Rosaceæ	Arizona.
Prunus demissa	Rosaceæ	S. California.
Ribes viburnifolia	Saxifragaceæ	S. California.
Epilobium angustifolium[1]	Onagraceæ	E. Massachusetts.
Arctostaphyllos oppositifolium	Ericaceæ	S. California.
Eriodictyon glutinosa	Hydrophyllaceæ	Arizona.
Gilia Rusbyi	Polemoniaceæ	Arizona.
Pentstemon secundiflorus	Scrophulariaceæ	Arizona.
Audibertia Clevelandii	Labiatæ	S. California.
Dracocephalum parviflorum	Labiatæ	Arizona.
Salvia ballotæflora	Labiatæ	Arizona.

The eggs are laid upon the plants or on any surrounding object. They are but slightly attached, bluntly ovoid, 0.3 mm. wide and 0.4 mm. long. They are steel-gray in color, the shell white with faint iridescence when empty, and faintly and irregularly reticulate. The duration of the larval period

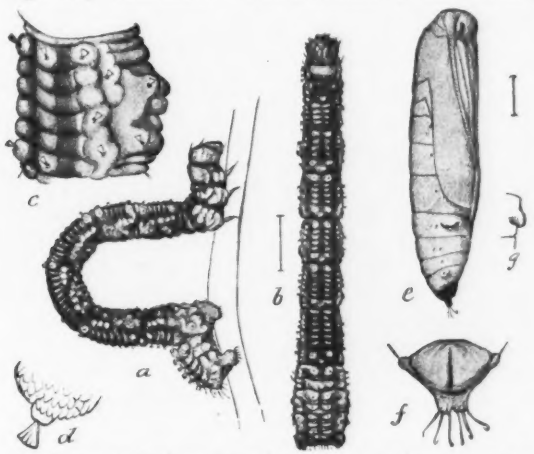

FIG. 1. *Carphoxera ptelearia: a*, larva from side; *b*, do. from above; *c*, side view of abdominal joint of same; *d*, tubercle of same; *e*, pupa; *f*, do. cremaster; *g*, do. abdominal projection.—*a*, *b*, *d*, enlarged about six times; *c*, *d*, *f*, still more enlarged. (Original.)

[1] E. angustifolium grows in the West but mostly in northern California and Oregon.

has not been determined. Growth, however, is very slow, and the period from the egg to the full larval growth is variable. The larval life extends in some cases certainly over a period of three months. When full grown the larvæ attain a length, extended, of 8 mm.; contracted when disturbed or at rest of 5 to 6 mm. Whenever disturbed they contract considerably and become rigid and motionless. The larva is shown in characteristic positions in the accompanying illustration (fig. 1, *a*, *b*). It is dull grayish in color, varying considerably in different specimens. On reaching full growth the larva constructs a cocoon of loose white silk, forming an irregular open network as shown in fig. 2, *b*. The cocoon is usually placed in a fold of the leaf or is otherwise protected by the plant, and is occasionally partly covered with bits of anthers or fragments of leaves. In shape it is irregularly ovoid and is about 6 mm. by 3.5 mm. The change to pupa takes place about three days after the cocoon is completed and the moth usually appears eighteen to twenty days after pupation. The pupa is 5 mm. in length, somewhat robust, and is slightly yellowish in color, with sutures and tip brownish, the latter being quite dark. A peculiar pad or flap-like projection occurs on the side of the fifth abdominal joint (fig. 1, *c*, *g*). The cremaster is produced, notched at the tip and armed with six long hooked hairs or spines (fig. 1, *f*). The adult insect is about 5 mm. long and expands from 13 to 14 mm. The general color is greyish-yellow inclining to saffron, the primaries being somewhat darker. The wings are marked (fig. 2, *c*) with transverse bands of dusky shade, and each wing has a discal spot. The head is dark brown, with the antennæ, including a large spot on the vertex, yellowish. The under surface is nearly concolorous, the dark bands being

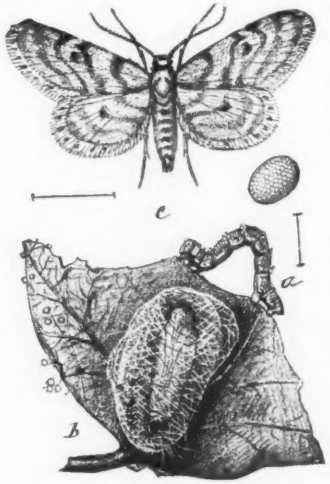

FIG. 2. *Carphoxera ptelearia*: *a*, larva; *b*, cocoon; *c*, moth; *d*, egg—all enlarged. (Original.)

less distinct, and the discal spot more intensified. The fringes are concolorous with the ground color and with black dots beyond the veins.

This insect has become a source of positive alarm in the Department herbarium on account of its rapid multiplication and the harm it occasions. It behooves botanists to be on the lookout for it and to adopt such measures as will insure immunity from it, if dry specimens are being received from Mexico and the southwest, or from herbaria in which it is known to occur. The custom of poisoning dried plants with corrosive sublimate to protect them from various enemies, such as book mites, Psoci, etc., should give immunity from the attacks of this insect if the poison has been thoroughly applied. If to the corrosive sublimate a quantity of arsenic is added, the protection will be more effectual. I would also recommend as very useful in disinfecting herbaria of this and other pests an air-tight quarantine box of zinc or galvanized iron in which the plants may be temporarily placed and submitted to the fumes of bisulphide of carbon, which are very sure to destroy all insect life. Effective steps have already been taken to prevent the sending out from the Department of any infested specimens in future.

The fact that this insect has appeared in dry plants from the comparatively arid western regions may furnish a clew to its original habit. It is presumable that it normally feeds on the dead or dried plants of Mexico and adjacent arid regions, and that it has simply adapted itself to the somewhat similar conditions prevailing in herbaria.

This is the first true Geometrid, so far as I know, recorded as feeding on dry and dead vegetation. In the Pyralidina a number of species are known to be not only truly carnivorous, feeding on other insects, but also to feed upon grass and rejectamenta as well as dead leaves. Some Tineina are also known to have similar habits, while in the Deltoid group of Noctuids several genera are known to feed on dead leaves.

The illustrations, which have been prepared for *Insect Life*, are used by permission of the Hon. Edwin Willits, Assistant Secretary of Agriculture, who desires to give the facts in the case as wide circulation as possible, and who is particularly anxious that the Department shall not be the means of distributing any undesirable introductions.

U. S. Dept. of Agric., Div. of Entomology.

Notes upon Peronosporeæ for 1891.

BYRON D. HALSTED.

The season now closing has been an average one as to the total amount of rainfall, but the two previous years were moderately wet ones, and particularly 1889. Of special note in this connection is the amount of rain that fell during the month of August, namely, 5.32 inches on an average throughout the state; while the September precipitation was not so great but near the average.

PHYTOPHTHORA INFESTANS D. By. While not one quarter as prevalent as last year this rot has not been absent, especially among the late potatoes. It was first observed in July, about ten days after a series of rains. The writer is more than ever convinced that much of the decay of Irish potatoes in the East is due to bacteria and the Phytophthora gets credit for much more damage than is its due.

SCLEROSPORA GRAMINICOLA (Sacc.) Schr. which is common upon *Setaria viridis* and *S. Italica* in Iowa, has not yet been found in New Jersey. The first host for this mildew gives one of the best illustrations of how the sustaining tissue breaks up into fine shreds as if to facilitate the dispersion of the oospores as it doubtless does.

PLASMOPARA VITICOLA (B. & C.) Ber. & De T. was comparatively rare upon the grape during the early part of the year, but after the crop was removed the mildew showed itself upon the mature leaves in remarkable abundance. So rapid and great was its growth in September that the vineyardists frequently mentioned the fact of their own accord. This seems to be a striking example of the mildew being associated with the moist weather of the autumn. It has been again observed that the lower leaves, that is, those nearest the soil, are the most certain to be attacked, leaves lying upon the earth being worst of all. It has not been as abundant upon *Ampelopsis quinquefolia* and *A. tricuspidata* as last year.

PLASMOPARA PYGMÆA (Ung.) Schrœt. was found in small quantity in early spring upon *Anemone nemorosa* but not met with upon its other hosts.

PLASMOPARA GERANII (Peck) Berl. was in early spring one of our most abundant and conspicuous members of the group, as upon *Geranium Carolinianum* it covered the leaves with a

white felt and developed a premature reddening of the affected foliage. In midsummer it disappeared only to appear again upon the seedling plants in autumn ready for its hibernation in the substance of its hosts. It was taken also upon *G. maculatum* but not upon *G. Robertianum.*

BREMIA LACTUCÆ Reg. has only been met with upon garden lettuce and principally in green-houses where it did some damage.

PERONOSPORA PARASITICA D. By. is one of the most widespread and common of all the mildews. It has been observed on nearly all the ordinary hosts, as *Cardamine hirsuta* and *C. laciniata* in early spring, and radish and cabbage later in the season. A new host apparently in *Alyssum maritimum* was found affected, growing in a green-house with radishes near by, likewise infested. The Cruciferæ in general are subject to the attacks of this mildew.

PERONOSPORA CUBENSIS B. & C. has been the most interesting species this season. It will be recalled that this mildew, in the spring of 1889, was known only in Japan, Cuba and this state. During that year it was found in the southern states. Last year it was only rarely met with, but almost daily looked for. Until midsummer of the present season it had not been found, but since then it has appeared, literally almost everywhere in this region, and through correspondence it is learned that it is very wide spread and general. From Professor Galloway I learn that it is abundant in Washington, and Dr. Sturgis sent specimens from New Haven, where it was common upon watermelon. Upon the same host it seems accountable for the failure of the crop to some extent in this vicinity. No oospores have been met with, but the rapid germination of the violet conidia by zoospores is easily demonstrated. The wild species of Cucurbitaceæ, namely, *Sicyos angulata* and *Echinocystis lobata*, have been examined with the hope of finding the mildew, but without success.

PERONOSPORA EFFUSA Rabh. has been much more abundant this season than formerly. The crop of spinach now standing in some places is badly spotted with the mildew, which will materially shorten the crop.

PERONOSPORA POTENTILLÆ D. By. has been taken occasionally upon the common host *Potentilla Norvegica*, but of most interest is the finding of it upon *P. grandiflora* which,

while recorded in Saccardo, is perhaps new to this country. The oospores were in abundance. It was also luxuriant upon *Potentilla Nepalensis*, in which also oospores were present.

CYSTOPUS IPOMŒÆ-PANDURATÆ Farl. has been abundant upon the sweet potato foliage and the oospores in the galls of the *Ipomæa pandurata* as mentioned last season. In no case were the galls found upon the former host.

CYSTOPUS CANDIDUS (Pers.) Lév. has its long list of hosts, and in this is a match for *Peronospora parasitica*, both frequently growing together upon the same species of Cruciferæ. Fine specimens with chalky white patches of large size were found unusually abundant upon some horseradish plants, and in this vicinity during June the shepherd's purse is fortunately quite seriously affected by this white mold.

CYSTOPUS PORTULACÆ (DC.) Lév. in like manner assists materially in killing off the purslane.

As a whole this has been a year in which the mid-season was characterized by few Peronosporeæ, but the quota has been well filled by the rapid development of several species in great abundance late in the season. The frosts of autumn held off unusually late, and this, together with the heavy rains, gave these parasites a good opportunity to make a rank growth. The other points of particular interest have been the finding of *Peronospora parasitica* upon *Alyssum maritimum; P. Cubensis* in great abundance upon cucumber, pumpkin and squash, and quite destructive to watermelons; *P. effusa* abundant upon spinach; and *P. Potentillæ* upon *Potentilla grandiflora* and *Potentilla Nepalensis*, both hosts abounding in oospores.

Rutgers College, New Brunswick, N. J.

New plants collected by W. G. Wright in western Mexico.

B. L. ROBINSON.

Ayenia Wrightii.— Fruticose: branches terete, smooth: leaves ovate, acuminate, rounded at the base, serrate, glabrous on both sides, a little paler beneath, 1½–2 inches long, half as wide; some much smaller leaves, 4–6 lines in length, fascicled together with the flowers in the axils of the larger

ones; petioles 3–9 lines long: flowers two to five in a group, without a common peduncle; pedicels 3 lines in length; sepals lanceolate, acuminate, about a line long; petals with blades broadly rhombic, entire at the attachment of the hair-like claw, but with four teeth near the apex, the two inner teeth very minute, close to the adnation to the staminal cup, the outer much larger, acuminate, abruptly bent downward and backward; anthers two-celled; ovary raised on a slender stipe of 1 line in length; fruit $1\frac{1}{2}$–2 lines in diameter, covered with numerous small dark glands.—Head of Mazatlan River, January, 1889 (No. 1307). Differs from *A. truncata* Rose in its terete branchlets, the longer and more slender stipe of the ovary and in the character of its fruit.

Mimosa affinis.—Annual, sensitive: stem ascending, simple or branched, hirsute with spreading or reflexed yellowish-brown hairs and armed with small recurved sub-stipular and scattered spines: petioles an inch long, bearing a single pair of pinnæ: leaflets 9–12 pairs, oblong, acutish, 5–7 lines long, the lowest pair appressed-pubescent upon the lower surface, the others nearly glabrous except on the ciliate margins; stipules awl-shaped, striate, ciliate; stipels bristle-formed, more or less rigid and dark-colored: peduncles shorter than the petioles, bearing small nearly spherical heads 2–$2\frac{1}{2}$ lines in diameter; bractlets awl-shaped to bristle-formed, ciliate, exceeding the flowers; corolla 4-parted; stamens 4; legumes 1–4 seeded, about 6 lines in length, $2\frac{1}{2}$ lines broad, the surface minutely pubescent, and the more or less persistent margins provided with numerous very short recurved hooks ($\frac{1}{4}$–$\frac{1}{2}$ a line in length).—Growing in grassy land among cocoanut trees, Mazatlan and vicinity, January, 1889 (n. 1218 and 1265). These plants having the habit of *M. pudica* L. differ constantly from that species in their smaller heads, and in the characters of the fruit. In M. pudica the legume is ciliate with less numerous, much longer, coarser bristles, which are not at all reflexed. Furthermore, the stipels in M. pudica are green and much less bristle-like.

Buddleia (§ GLOBOSÆ) **Wrightii.**—Shrub: branches and branchlets slender, terete, minutely striate, smooth: leaves thin, lanceolate, sharply acuminate, long-attenuate to a slender slightly margined petiole, serrate, covered on both surfaces with a close and inconspicuous canescent stellate puberulence, green

above, paler beneath, including petiole 4–5 inches long, 1–1¼ inches wide, the uppermost smaller, entire: peduncles in pairs, axillary, smooth, 5–10 lines long; heads 5–6 lines in diameter; calyx tomentous, obtusely four-toothed; corolla 1½ times as long as the calyx, hairy within; stamens and clavate entire stigma included. — A "willow-like bush," head of Mazatlan River, January, 1889 (n. 1282). Distinguished from the South American *B. globosa* Lam., *B. polycephala* HBK. and others by its thinner leaves and the absence of the dense ferruginous tomentum characteristic of those species; from *B. connata* Ruiz et Pav. by its narrow petioles, which are merely connected by a line and are not truly connate.

Citharexylum Cinaloanum. — A slender shrub, 4 feet high: branchlets striate, roundish or slightly 4-angled, canescent-tomentulous: leaves ovate or oblong, usually acuminate, rarely obtuse at the apex, acute at the base, entire or with a few shallow teeth toward the apex, pale, nearly glabrous but slightly roughish above, with short canescent tomentum beneath, 1¼–2½ inches long, half as broad; petioles 2–4 lines long: spikes single, terminal, slender, nodding; bractlets minute, subulate; flowers subsessile; calyx campanulate, 1 line long, striate, pubescent, with 5 very short acuminate slightly spreading but not reflexed equal or sub-equal teeth; corolla white, pubescent within and without, exceeding the calyx by half; segments erect; fertile stamens four; rudiment minute; style glabrous; fruit dark, 2 lines in diameter. — Mazatlan, January, 1889 (n. 1225). Very nearly related to *C. Berlandieri* Robinson, but differing in its larger, usually more acuminate leaves, its campanulate rather than turbinate calyx with acute instead of blunt lobes, in the erect lobes of the corolla, and the glabrous style; the corolla-lobes in C. Berlandieri being larger and more spreading and the upper part of the style puberulent.

Gray Herbarium, Cambridge, Mass.

Noteworthy anatomical and physiological researches.

CONWAY MAC MILLAN.

Influence of gravity on sleep-movements.[1]

Fischer has attempted in these researches to discover the influence of gravitation upon the positions assumed by nyctitropic organs during the changing diurnal and nocturnal conditions. The method of experimentation adopted was simple. Two groups of cultures were arranged, in one of which plants were placed in abnormal inclinations to the plane of gravity-stimulation, while in the other, the plants were rotated upon the klinostat. By these means it was possible to show that the plants experimented upon could be grouped in two classes: (1) those which continued the nyctitropic movements regardless of the direction from which the force of gravity acted; and (2) those which failed to assume nyctitropic positions in the absence of normal gravity-stimulus. The first group of plants — to which belong Trifolium pratense, Portulaca sativa, Cassia Marylandica, Oxalis lasiandra, Acacia lophantha and others — is named by Fischer *auto-nyctitropic.* The second group, apparently smaller than the first, includes Gossypium arboreum, Phaseolus multiflorus, Lupinus albus and certain Malvaceæ, and is named *geo-nyctitropic.* These experiments, if extended, might be fruitful in explaining some difficult problems in plant positions. It would seem particularly desirable to determine, if possible, for a number of plants, the critical angle at which nyctitropic movements fail to appear. This is a line which might easily be investigated in many American laboratories.

Effects of transpiration and darkness on form.[2]

Wiesner here continues experimentation somewhat along the line indicated by Palladin and others, with reference to the connection between the form of a plant and its rate of transpiration. He has examined more particularly those plants which normally form a basal rosette of leaves, as in the case of Taraxacum, Capsella, Sempervivum, etc. He finds that

[1] A. Fischer: Ueber den Einfluss der Schwerkraft auf die Schlafbewegungen der Blætter. Botanische Zeitung, 1890.

[2] J. Wiesner: Formænderung von Pflanzen bei Culture im absolut feuchten Raumer und im Dunkeln. Berichte der deutschen bot. Gesellsch., 1891, p. 46.

the behavior of different plants in a saturated atmosphere is by no means the same, but that there may be distinguished at least four types.

(1) The rosette of radical leaves is loosened through lengthening of internodal areas, both in darkness and saturated atmosphere. This is the case in Sempervivum tectorum.

(2) There is no change of shape in obscurity or in a saturated atmosphere. This is the case in Oxalis floribunda and Plantago media.

(3) The plant undergoes dissociation of the radical rosette in darkness but is unaffected by a saturated atmosphere. This is the case in Taraxacum officinale.

(4) The radical rosette is dissociated in the saturated atmosphere but is unaffected by obscurity. This is the case in Capsella bursa-pastoris.

Wiesner holds that in type 1 the internodal elongations are in both cases due to increased transpiration. Type 2 he finds difficult and calls into court that witness of last resort, heredity, saying that there has been produced a *phylogenetischen Entwicklung* which can not be modified by changing conditions in the life of a single culture plant. Type 3 is explained by considering that light retards growth while transpiration has little or no effect, and Type 4 indicates that transpiration may be the condition of extended growth, while light has little influence, or none at all.

It does not seem at all certain that all of these explanations are final. Type 2 could be better explained by some cause separate from those investigated, acting either actively or conservatively, to modify or inhibit the influence of the light and transpiration current. The writer called attention in the GAZETTE of May, 1890, to a peculiar epinastic position of Solanum leaves under certain conditions which, he has since come to believe were principally of modified transpiration. This same plant was afterward examined by Vöchting [4] and very good photographs given of the peculiar epinastic position. The Solanum plant also behaves in an interesting manner in a saturated atmosphere, assuming much the appearance of an etiolated plant. This was recently determined at the laboratories of the University of Minnesota. In a saturated atmosphere the leaves, however, continue to be strongly

[4] H. Vöchting: Laubblætter und Assimilationthatigkeit. Bot. Zeit., vol. 49, no. 9.

epinastic, although exceedingly small. There is also a formation, of course, of chlorophyll, and these differences suffice to distinguish between the etiolated and *hydrolated* plant. The interesting point is the permanent epinasty induced by atmospheric hydrolation; it is quite as marked in the small hydrolated leaves of Solanum tuberosum as in the large normal leaves of the same plant. Along this line further researches would supplement Wiesner's work and probably confirm and extend the investigations of Palladin. At any rate the Solanum tuberosum is recommended as a highly sensitive hydrolitic plant, and its further examination suggested to botanical workers as of much probable interest.

A monograph of plant-torsions.[1]

It is quite impossible to do justice to this voluminous and painstaking record of physiological research in a brief review. Mention will be made, therefore, of but one among the very numerous points of interest. In his researches upon the torsions in plant-organs, De Vries has had occasion to study particularly the Dipsacus sylvestris, a plant prone to exhibit these anomalous twistings of stems and leaves. He has accordingly cultivated the plant for many years in the botanical garden at Amsterdam. In six years, by careful selection, this distinguished investigator has established a variety of the teasel which is so constantly characterized by torsions in the stem and leaves that he proposes for it the name of Dipsacus sylvestris torsus. That these monstrous plants can be so rapidly produced by a systematic process of seed-selection is indeed worthy of note. For figures and descriptions the reader is referred to the article itself, which is one of the two or three most notable botanical works of the past year.

University of Minnesota, Minneapolis.

BRIEFER ARTICLES.

Atriplex corrugata, n. sp.— Dicœcious, shrubby at base, much branched, about a foot high, hoary throughout with a dense scurfy pubescence, very leafy: leaves linear-oblanceolate or -oblong, obtuse

[1] Hugo de Vries: Monographie der Zwangsdrehungen. Pringsheim's Jahrbücher für wiss. Botanik, xxiii, pp. 13–206.

or acutish, entire, 3 to 6 lines long: staminate flowers in short crowded terminal spikes; pistillate flowers in axillary clusters; bracts thick and spongy, 1 ½ to 2 lines long, obovate, united to above the middle, the free margins above broad and truncate or rounded or acutish, entire, the sides very variously and irregularly appendaged with spongy tubercles or crests which have usually a corrugated appearance when dry.—Nearly allied to *A. Nuttallii*. Discovered by Miss Alice Eastwood at Grand Junction, Colorado, in well formed fruit on 20th May, 1891. Miss Eastwood notes it as the earliest in fruit of several perennial species of the genus growing in the same locality.

RANUNCULUS GLABERRIMUS, Hook.—This common alpine species of the western mountains is much more variable in several respects than the published descriptions would indicate. The leaves vary from broad to narrow, and though the cauline leaves are ordinarily lobed, at least some of them, yet it occasionally happens that all are entire. The plant is as a rule wholly glabrous, but the sepals are sometimes sparsely villous with white hairs, and the achenes are either smooth or finely pubescent. This more pubescent form, as collected by Mr. Siler in southern Utah with entire leaves, was referred by Dr. Gray to *R. Lemmoni*, which species is as yet known only from the original locality in the Sierra Nevada.

RANUNCULUS MACAULEYI, Gray.—Fine fruiting specimens of this rare species have been recently collected by Miss Eastwood in the Elk Mountains above Irwin, Colorado. The achenes are small, in an oblong-ovate head, smooth, somewhat compressed, and beaked with a rather long linear-subulate straight style. The species appears to be well distinguished from *R. Altaicus* by its pilose-ciliate leaves, glabrous linear-oblong receptacle, and longer styles.—SERENO WATSON, *Cambridge, Mass.*

The sterile flowers of Panicum clandestinum.—The past season there was brought into the laboratory by a student a specimen of this species in which the sterile flowers had three well developed stamens. According to Gray's Manual, the lower or sterile flower is "(always?) neutral." On examination of a large number of specimens from this vicinity, it was found that by far the greater number had the lower or sterile flowers staminate. Specimens from Nebraska showed many staminate flowers also. Michigan specimens had the sterile flowers neutral. It was also observed that specimens collected early in the season had a larger number of staminate flowers than those collected later.—THOS. A. WILLIAMS, *State Agricultural College, Brookings, S. D.*

Peculiar forms of proliferation in timothy. (WITH PLATE XXVI.)—In a small plat of Timothy growing on the Experiment Station

TOUMEY on PROLIFERATION

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grounds of the University during the past season, a number of specimens showing these two forms of proliferation were found. Such specimens were especially numerous along an irrigating ditch which ran through the plat. This abnormal development was probably the effects of an over-supply of water. The form *A*, I have observed before. It is frequently produced in wet seasons on low and cold soil. In this case the floral glume is changed to a leaf, with other parts of spikelet normal. *a* represents an enlarged spikelet.

In the form *B* the spikelet is much changed from the normal. In a number of specimens there are four glumes, from between the inner pair of which extends a long stipe, generally more or less twisted and surmounted by a perfect flower. In some cases there are but two glumes below, with long stipe and perfect flower as before. In either case the glume above is very large, sometimes changed to a leaf, while the palet is inconspicuous, or there is none at all. *b* represents a spikelet of this form with four glumes below.— J. W. Toumey, *Botanical Laboratory, Univ. of Arizona.*

Iris hexagona.— In August, 1889, I collected at Carlinville in south-central Illinois fruiting specimens of an Iris whose species was not at the time determined because of the absence of flowers. In the season of 1890 the flowering period of the species passed without observation. A special watch was kept during the past summer and in early June the plant was taken in full bloom. With the exception of two points, viz., size of capsule and distribution the features of the plant tallied with the description of I. hexagona. Specimens were therefore sent to Dr. Sereno Watson who identified it as above designated. While the known distribution would suggest its occurrence in this state a careful search has found no record of such occurrence.—W. E. Andrews, *Carlinville, Illinois.*

EDITORIAL.

Our readers are invited to inspect carefully the table of contents and list of contributors which accompany this number. By doing so they will get a comprehensive view of "the high character and variety of the original communications"— to use the commendatory phrase of one of our most eminent friends. The printed pages bear evidence of much valuable research which we esteem it a privilege to publish. Our readers have a large and distinguished company to

thank for whatever of interest and instruction they have gained from the journal during the past year.

THE CLASSIFICATION of the original articles is of some interest. Naturally taxonomy and morphology lead with 44 titles, of which 32 belong to phanerogams and 12 to cryptogams; physiology stands next with 17 (including four entries relating to flowers and insects); anatomy and development have 10; teratology and variations 6, apparatus and methods 4; plant diseases 2; and reports of societies, etc., 5. Making allowance for the various other places of publication the relative numbers of articles probably represent fairly the character of work which is now going on, if we except the study of plant diseases. The economic bearings of this study usually determine the publication of articles on these subjects elsewhere.

WHEN THE great increase in sources of publication is considered it is rather surprising that the supply for a journal covering so wide a field as this continues unabated. The *Bulletins* of the Agricultural Experiment Stations, the *Proceedings* of various societies and academies, the *West American Scientist*, *Zoe*, the *American Naturalist*, the *American Journal of Science*, the *American Garden*, *Garden and Forest* and other similar journals contain many botanical articles; the *Annals of Botany* takes off some of the longer papers; while the *Bulletin* of the Torrey Botanical Club and the *Journal of Mycology* are replete with original articles and summaries of current work. Is there, by reason of these abundant sources of publication, temptation to the sending out of hasty and incomplete work?

THE EDITORS' LABOR during the year has not been inconsiderable. Twenty works have received extended review, and nearly fifty shorter notices have been written to keep abreast of the "Current Literature" sent to our table for review. Under the heading "Notes and News" have appeared nearly 200 items, giving a great variety of information about current events in the botanical world. This, together with the routine work connected with the regular issuance of the journal, has involved an expenditure of energy which few can appreciate who do not know it from experience. It has been to the editors a labor of love, however. They hope that the readers of the GAZETTE have been helped by it to a wider knowledge and a more zealous study of the science which we all delight to honor.

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ATTENTION is called to the announcements on the last page of the cover.

CURRENT LITERATURE.

Minor Notices.

EVER SINCE homologies were known to exist between heterosporous pteridophytes and phanerogams the genus Isoetes has been one of peculiar interest, for it has seemed of all known pteridophytes most nearly related to phanerogams. Dr. Douglas H. Campbell, whose work in the life-histories of pteridophytes is well known, has made a careful study of the life-history of a species of Isoetes (I. echinospora, var. Braunii), and has published his results in *Annals of Botany* (Vol. V. no. 19, Aug. 1891), illustrated by three double plates. He has traced the development of the male prothallium, the macrospore and female prothallium, and the embryo as to its leaf, root, and foot). While the details of technique are both interesting and instructive, for the subject was beset with unusual difficulties of manipulation, the interest naturally centers about the conclusions with regard to the relationship of Isoetes. The genus has been ordinarily placed among the Lycopodineæ, although Vines has called attention to its closer relationship to Filicineæ, to which latter view Campbell also inclines, and his results seem to bear him out in this view. However, Isoetes still seems widely isolated at best, and its relationship to Filicineæ, while nearer than to any other pteridophyte group, may still be considered a somewhat distant one. While nearest to the Filicineæ, it still seems to have closer homologies with phanerogams than any other pteridophyte. Campbell has succeeded in making the very important point that these homologies are with the monocotyledons rather than with the gymnosperms, thus emphasizing the notion of the independent origin of the angiosperms from the pteridophytes and the further notion of the origin of monocotyledons from the Filicineæ through such forms as Isoetes. Of course the intervals are still far too great for definite conclusions, but these results with Isoetes are full of suggestions for future investigations.

THE SEVENTEENTH contribution from the cryptogamic laboratory of Harvard University is by William Albert Setchell, under the title "Concerning the life-history of Saccorhiza dermatodea." It is a reprint from Proc. Am. Acad. XXVI., distributed September, 1891. It deals with a very complex and polymorphous member of the Laminarieæ. Dealing first with its discovery by De la Pylaie, its distribution, habitat, and season, the author treats its morphology under four periods, each characterized by some important changes in development. Then follows a complete account of the histology of each of these per-

iods, and then a discussion of relationships to certain specific forms and other Laminarieæ in general. That the species is a polymorphic and somewhat confusing one may judge by the fact that in literature it appears under five generic names with nine different specific combinations.

In an article entitled "The vitality of some annual plants," reprinted from the October number of the American Journal of Science, Mr. Theo. Holm instances a number of annual plants of which he has found individuals having arrangements for living over winter.

Mr. Henry Eggert has published a catalogue of the Phanerogams and Pteridophytes in the vicinity of St. Louis, the radius being about 40 miles. This is the first complete list of this interesting region since Geyer's Catalogue of 1842. The list contains about 1100 species, and Mr. Eggert's long and patient study of the St. Louis flora insures a list both complete and accurate.

NOTES AND NEWS.

Dr. Aug. F. Foerste sailed for Europe the middle of last month, and is now at the Collége de France, Paris.

On page 273 the Gazette tried say that Mr. T. *Kirk* of Wellington, New Zealand, was preparing plants of that country for distribution at *45 shillings* per century.

Dr. Arthur Meyer has been called to the professorship of botany in the University of Marburg. Dr. F. G. Kohl, heretofore *privat-docent*, has been made assistant-professor.

Dr. Hermann Hoffmann, professor of botany in the University of Giessen, is dead at the age of 72. Plant climatology, geography and phænology are the branches to which he gave especial attention. Indeed the latter subject owes most of its present development to his labors.

Three of the six established scholarships for garden pupils of the Missouri Botanical Garden (St. Louis) are to be awarded before the first of April next. Those who desire full information concerning the great advantages offered by these scholarships, and the conditions upon which they are awarded, should address the Director, Dr. William Trelease.

[1] pp. 292—309, with plate XIII.

GENERAL INDEX.

*** The more important classified entries will be found under the following heads: *Diseases, Geographical Distribution, Hosts, Journals, Necrology, Personals, Reviews.*

*** Names of synonyms are printed in *Italics;* names of new species in **boldface**; † signifies death.

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p. 22, line 7, for hyhæ read hyphæ.
p. 26, line 2, for inside read method.
p. 26, line 9, for Sigmiodeomyces read Sigmoideomyces.
p. 26, line 11, for when read where.
p. 62, line 3, for Colletotrichium read Colletotrichum.
p. 76, line 9 from bottom, for inclines read inclined.
p. 77, last line, *dele* not.
p. 100, line 12, for oxylepsis read oxylepis.
p. 107, line 10, insert S. after 17.
p. 137, line 3 from bottom, for sap read sop.
p. 138, line 3, for sap read sop.
p. 138, line 20, for savory read curry.
p. 139, line 12, for mashed read washed.
p. 139, line 4 from bottom, for ocara read ochra.
p. 139, footnote 41, for Lechium read Sechium.
p. 140, line 2, for pie read pea.
p. 140, line 5, for roots read nuts.
p. 140, line 15, for Lucca read Lucea.
p. 147, line 18 from bottom, *dele* n. sp.—The species was previously described in the *West American Scientist*.
p. 149, line 18 from bottom, for sasisfactory read satisfactory.
p. 188, line 22, insert Station after Experiment.
p. 199, line 16 from bottom, for Pirus read Pinus.
p. 210, line 13, insert translation of before Strasburger's.
p. 213, make $\left\{\begin{matrix}\text{syncarpous}\\\text{apocarpous}\end{matrix}\right.$ follow compound.
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